What's the seismic risk perception in Italy?

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Risk perception is a fundamental element in the definition and the adoption of preventive counter-measures. In order to develop effective information and risk communication strategies, the perception of risks and the influencing factors should be known. This paper presents preliminary results of a survey on seismic risk perception in Italy. The research design combines a psychometric and a cultural theoretic approach. More than 5,000 on-line tests have been compiled from January 23rd till July 25th, 2013. The data collected show that in Italy seismic risk perception is strongly underestimated; 86 on 100 Italian citizens, living in the most dangerous zone (namely Zone 1), do not have a correct perception of seismic hazard. From these observations we deem that extremely urgent measures are required in Italy to reach an effective way to communicate seismic risk.

Keywords: Risk perception, Seismic hazard, Hazard communication, Seismic risk.

"This study has benefited from funding provided by the Italian Presidenza del Consiglio dei Ministri - Dipartimento di Protezione Civile (DPC). This paper does not necessarily represent DPC official opinion and policies".

1. Risk perception

Risk perception research in the domain of technical risks has shown that peoples' perception of risk is subject to many influencing cognitive, personal, situational and contextual factors (Sjöberg, 2000a). Because of its complexity, it is very difficult to deduce general statements or a general theory of risk perception (Wachinger, G. & Renn, 2010). Nevertheless, knowledge about the risk perception of persons living in risk prone areas is relevant whenever risk management strategies have to be developed or applied.

A number of approaches and concepts have been applied in risk research to study risk perception: the approach known as psychometric paradigm (Fischhoff et al. 1978a; Slovic, 1987, Slovic, 1992) and similar concepts (Lindell, 1994), the cultural theory of risk perception (Douglas & Wildavsky, 1983; Thompson et al., 1990; Dake, 1991, Dake, 1992), trust-oriented concepts (Slovic, 1993; Siegrist, 2000a; Siegrist, 2000b, Siegrist, 2000c), the mental models approach (Lave & Lave, 1991), concepts to include associations and affect (Peters & Slovic, 1996), demographic variables (Savage, 1993; Barke et al., 1997), gender (Gustafson, 1998; Greenberg & Schneider, 1995) and others. Risk perception has been investigated with various methods on different risk levels (individual personal risk or risk for the general society), using various risk measures (magnitude of risk, overall risk rating, probability of an event, estimated fatalities per year) and several risk dimensions (probability of damage, personal death/injury, property loss, interference with work, social disruption; see Rohrmann, 1999; Sjöberg, 2000b; Lindell & Perry, 2000). For the investigation of risk perception from windstorm, flood and earthquake the psychometric approach (Fischhoff et al., 1978b; Slovic, 1987, Slovic, 1992) and theoretical concepts of cultural theory (Thompson et al., 1990; Dake, 1991) were applied to reveal the underlying cognitive structure of risk and the influence of social values and worldviews.

In addition to the psychometric approach and cultural theory of risk, our research design included some further components to obtain a better overview on possible influences on risk perception: causes attributed to disasters, images of and associations on nature and environment (Szalay & Deese, 1978), several personal and demographic characteristics, and experience from past events.

2. The test

Within the project S2-2012 - *Constraining Observations into Seismic Hazard* financed by Department of Civil Protection (http://sites.google.com/site/ingvdpc2012progettos2/home), an on-line questionnaire on the perception of seismic risk was prepared and tested. The test was constructed by the method of semantic differential, based on bipolar scales of opposing adjectives or terms (Osgood et al., 1957). The subjects had to indicate, on a scale of 7, "which of the two poles" the object of investigation was closer to in their opinion (Plapp & Werner, 2006; Crescimbene, 2008; Zacchi & Crescimbene, 2010).

The test was constructed on the factors that determine the seismic risk: hazard, exposure, and vulnerability. Other factors related to Institutions and People and to Earthquake perception in general are also considered.

The whole test consists of an informative part and seven sections respectively dedicated to:

1. Hazard

2. Vulnerability (home and workplace)
3. Exposure (with reference to territory perception)
4. Perception of institutions and people
5. Earthquake perception
6. Risk information and their sources
7. Comparison between earthquake and other natural hazard.

Assigned to each factor is a set of scales to which it is possible to assign a score from 1 to 7, Likert scale (Likert, 1932).

The test makes it possible to obtain a perception score for each factor: Hazard, Exposure, Vulnerability, Institutions and people perception, Earthquake perception. Considering all these factors the global risk perception total score can be derived. The complete test is accessible at: http://www.terremototest.it.

3. The survey

The seismic risk perception survey began on 22 January 2013 and it is still underway. Compilation availability and accessibility has been spread through the social network, the web pages of regional, provincial, and municipal websites and on local online newspapers. The diffusion of the test was deliberately conducted through general interest locations, avoiding the specialized or official sites of the sector (Department of Civil Protection, INGV, OGS, universities, etc..) in order to limit the bias of educated/oriented samples.

The survey includes all the Italian regions; on 25 July 2013, 5,585 tests had been compiled, subdivided in Administrative units (Region) and seismic zones (hereinafter described) as shown in Table 1. Veneto Region represents over 1/3 of the sample, as a local newspaper in the Verona area advertised the initiative.

Regions	Seismic Zones				
	Zone1	Zone2	Zone3	Zone4	Total
Abruzzo	58	83	50	0	191
Basilicata	41	50	5	0	96
Calabria	97	54	0	0	151
Campania	62	255	24	0	341
Emilia-Romagna	0	93	361	6	460
Friuli-Venezia Giulia	2	36	15	0	53
Lazio	16	215	34	0	265
Liguria	0	0	57	5	62
Lombardia	0	9	88	246	343
Marche	3	103	4	0	110
Molise	19	22	1	0	42
Piemonte	0	0	57	92	149

Puglia	0	47	60	39	146
Sardegna	0	0	0	23	23
Sicilia	35	178	2	5	220
Toscana	0	128	469	10	607
Trentino-Alto Adige	0	0	17	32	49
Umbria	1	51	3	0	55
Valle d'Aosta	0	0	1	4	5
Veneto	0	75	1906	236	2217
Total	***334***	***1399***	***3154***	***698***	***5585***

Table 1 - Distribution of the sample by regions and hazard zones.

4. Data processing

More than 5,000 questionnaires were compiled in few months, without any specific initiative supported by the press or the mass-media. The first analysis of data is a comparison between hazard perception scores and the so-called “hazard by law”, i.e. the seismic hazard assessment assigned to a particular territory by experts (Gruppo di Lavoro MPS 2004; Stucchi et al. 2011); we resorted to a simplistic subdivision of Italian municipalities in 4 seismic zones, as given by regional laws as they were in 2012 (http://www.protezionecivile.gov.it/resources/cms/documents/A3_class2012_03prov_.pdf). The assigned scores are shown in Table 2. Note that in seismic zone 1 is not possible to have overestimated scores because we assumed that suited for this zone are scores of 6 to 7 (it’s useful to remember that 7 is the highest score obtainable on the scale).

<table>
<tr><th rowspan="2">Seismic Zone</th><th colspan="6">Semantic Differential Scores
(7 points Likert's Scale)</th></tr>
<tr><th>1-2</th><th>2-3</th><th>3-4</th><th>4-5</th><th>5-6</th><th>6-7</th></tr>
<tr><td>Zone 1</td><td colspan="3">-3
underestimated of 3 points and over</td><td>-2
underestimated of 2 points</td><td>-1
underestimated of 1 point</td><td>0
good fitting</td></tr>
<tr><td>Zone 2</td><td colspan="2">-3
underestimated of 3 points and over</td><td>-2
underestimated of 2 points</td><td>-1
underestimated of 1 point</td><td>0
good fitting</td><td>+1
overestimated of 1 point</td></tr>
<tr><td>Zone 3</td><td>-3
underestimate of 3 points</td><td>-2
underestimated of 2 points</td><td>-1
underestimated of 1 point</td><td>0
good fitting</td><td>+1
overestimated of 1 point</td><td>+2
overestimated of 2 points</td></tr>
</table>

Zone 4	-2 underestimated of 2 points	-1 underestimated of 1 point	0 good fitting	+1 overestimated of 1 point	+2 overestimated of 2 points	+3 overestimated of 3 points

Table 2- Interpretation of Hazard Perception scores (HP) respect to Hazard by Law (HbL).

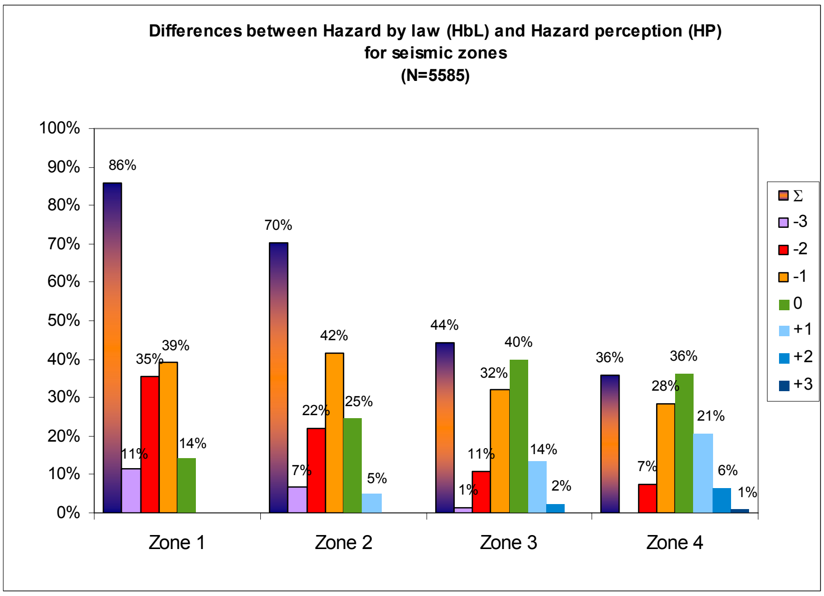

Figure 1 - Frequency distribution of differences in Hazard perception for seismic zone.

The histogram in Figure 1 shows that, in seismic zone 1, only 14% of the sample has a good perception (green column) of the seismic hazard, while 86% of surveyed people underestimate the earthquake-related phenomena (39% underestimated by 1 zone/class, 35% underestimated by 2 zones/classes, 11% underestimated by 3 zones/classes).

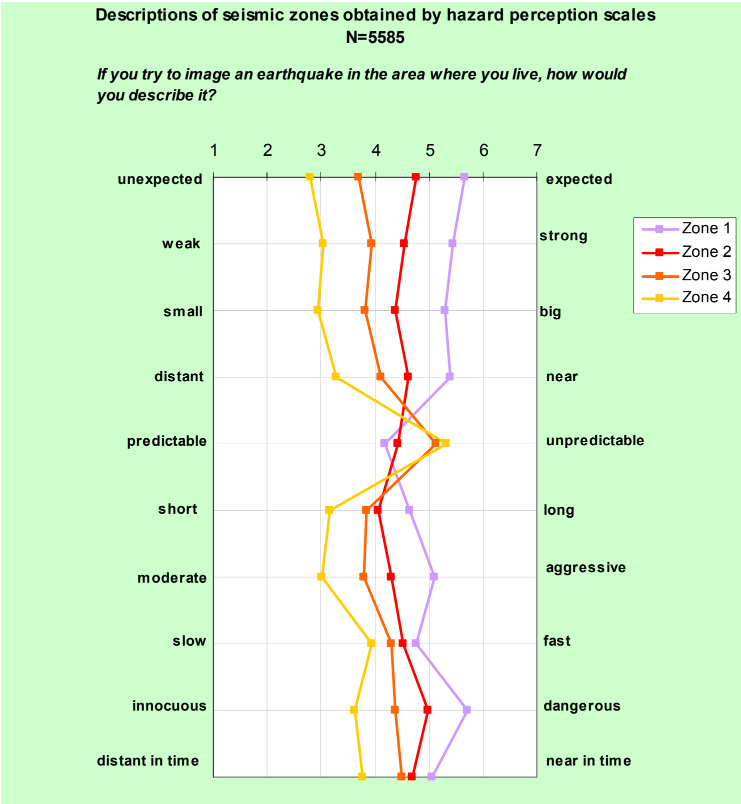

Figure 2 - Descriptions for seismic zone obtained by hazard perception scales (HP).

Figure 2 shows in details the description for seismic zones obtained by hazard perception scales (HP). The colored lines represent the trend of scales in each seismic zones (all the samples considered). The zones appear well distinct for almost all the terms, and the descriptions well represent each seismic zone. Referred to our test interpretation (see Table 2), Zones 1 and 2 appear to be strongly undervalued with an average score of 5.12 in Zone 1 (whereas it should be included in the range from 6 to 7) and of 4.53 in Zone 2 (against 5 to 6 as expected). Hazard perception in Zone 3 with an average score of 4.15 is placed on the limit of appropriate range between 4 and 5. Only hazard perception in Zone 4 with an average score of 3.49 is a good match between hazard by law (HbL) and hazard perception (HP). It's worth mentioning that the scale "predictable-unpredictable" gets inversion in scores (the most hazardous the country is, the most predictable earthquakes are); it demonstrates that predictability of earthquakes is perceived independently form any other cognitive and expertise factors. This result is consistent with outcome of debates recently underway in public opinion with respect to the possibility of predicting earthquakes.

5. Conclusions

In the scientific community there are numerous tools and maps to communicate the current knowledge about seismic hazard.

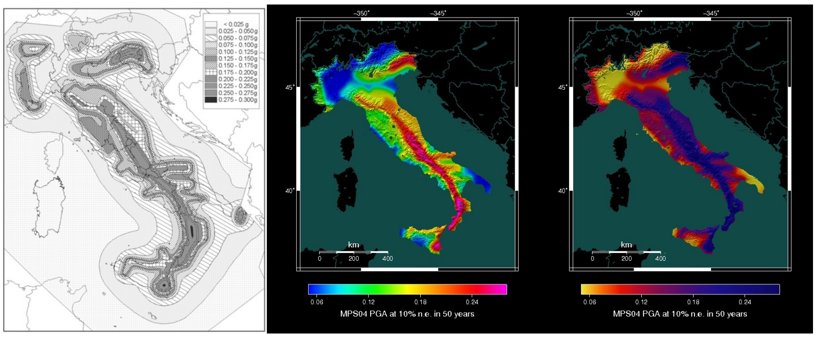

Figure 3 – Italian Seismic Hazard Map (MPS04, Stucchi et al. 2011): it displays the Peak Ground Acceleration (PGA) that in 50 years will not be exceeded 9 times on 10. Graphics has a strong impact on risk perception. On the left frame, the map published by the law 3519/2006.

From our study, a strong tendency to underestimate the seismic phenomenon in the most dangerous areas emerges: the problem of perception underestimation can not be simply attributed to a lack of dissemination of information; 61% of the sample (N=5,585) consider to be "somewhat" (45%) and "very" (16%) informed about the earthquake and only 8% says it's "not at all" informed. Furthermore, people declare to receive information about earthquake by reliable sources: 30% from the Department of Civil Protection, 15% by Regions, Provinces and Municipalities; 13% from research institutes, universities and schools, only 38% from traditional media (television, newspapers, internet, books).

The problem may be related to both the selfsame content of the communication and to the possible *bias* in the communication process. For these reasons an in-depth analysis of some aspects of the seismic risk communication would be needed: complex concepts such as those of hazard rate, the choices in graphical representations (and the color usage, see the example of Figure 3); the simplifications that reduce hazard values to simple adjectives (strong, moderate, negligible, etc.); the use of technical terminology which has possible different meanings in common usage. All these elements have to be carefully considered. It suffices to consider, for example, the different meaning it the numbering of seismic zones has in common sense, where Zone 1, the most dangerous, is perceived, with a reversal of meaning, as less dangerous than Zone 4.

In conclusion we can say that the seismic hazard perception data, described in this study, show unequivocally that in Italy an effective communication of seismic risk may no longer be postponed.

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